MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

BACHELOR OF SCIENCE (ANALYTICAL CHEMISTRY)

BACHELOR OF EDUCATION (SPECIAL EDUCATION)

BACHELOR OF SCIENCE (MATHEMATICS)

BACHELOR OF EDUCATION (SCIENCE)

BACHELOR OF SCIENCE (BIOLOGY)

SCH 102: ORGANIC CHEMISTRY I

DATE: 2/5/2019 **TIME: 2.00-4.00 PM**

INSTRUCTIONS TO CANDIDATES

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

SECTION A - COMPULSORY.
QUESTION ONE (30 MARKS)

a) Monosodium glutamate (MSG) has sometimes been suspected as the cause of "Chinese restaurant syndrome" because this food-flavour enhancer can induce headaches and chest pains. MSG has the following composition by mass; 35.51% carbon, 4.77% Hydrogen, 37.85% Oxygen, 8.29% Nitrogen and 13.60% Sodium. Its molar mass is 169 g/mol. Determine its:

i. Empirical formula (3 marks)

ii. Molecular formula (2 marks)

b) Draw the structures of the following named compounds:

i. 1-ethyl-3-floro-2-isopropylcyclohexane

ii. 2-bromo-5-ethyl-2,2-dimethyl-4-nitrooctane

iii. 2,3,4-trimethyl-1,3-hexadiene

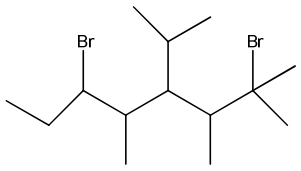
iv. 5-methyl-1,3-cyclohexadiene

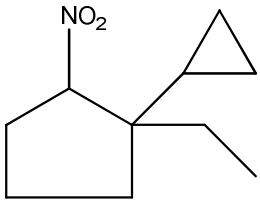
v. 3-bromo-2-hepten-4-yne

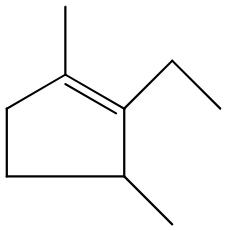
vi. 3-ethyl-2-nonene

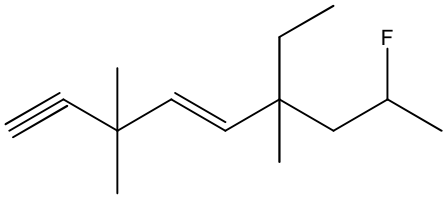
vii. 1-ethyl-3,3-dimethylcyclopentene (7 marks)

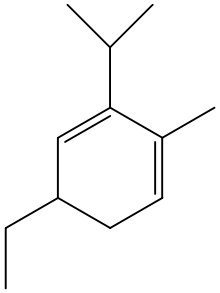
c) Provide the IUPAC names for the following structures:

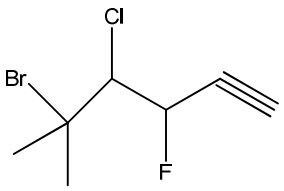
i) 

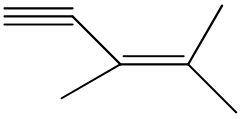
ii) 

iii) 

iv) 

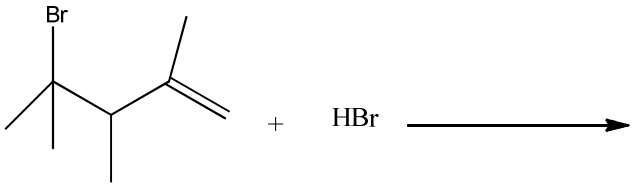
v) 

vi) 

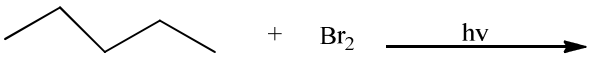
vii) 

(7 marks)

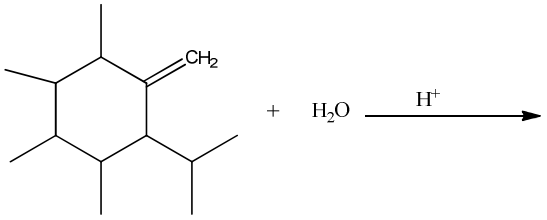
d) Provide the product(s) of each of the following reactions (more than one product may be formed).

i) 

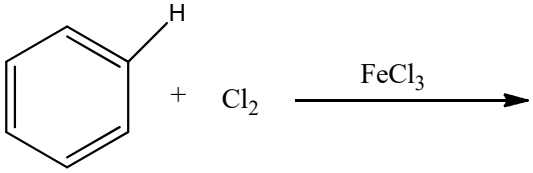
(2 marks)

ii) 

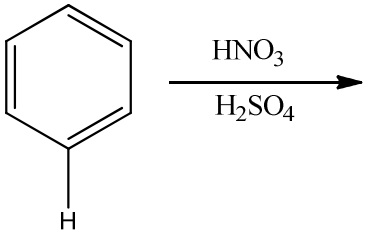
(2 marks)

iii) 

(2 marks)

iv) 

(1 mark)

v) 

(1 mark)

e) Heptane has a higher boiling point than 3-methylhexane and 2,2-dimethylpentane. Explain (3 marks)

SECTION B

ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

a) Draw the structural formulae for the following molecules.

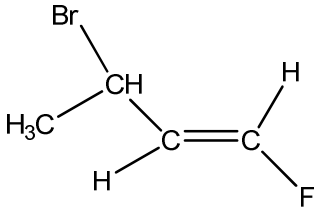
i. *Meta*-nitrophenol

ii. 3-phenyloctane

iii. *Ortho*-methyltoluene

iv. 2,5-dibromobenzoic acid (4 marks)

b) By assigning *cis and trans* name the following structures



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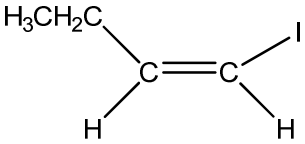
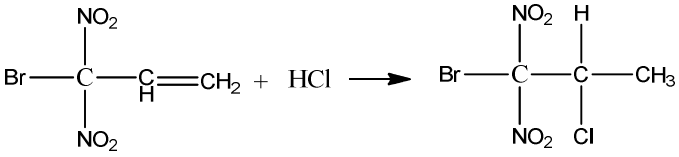


II (2 marks)

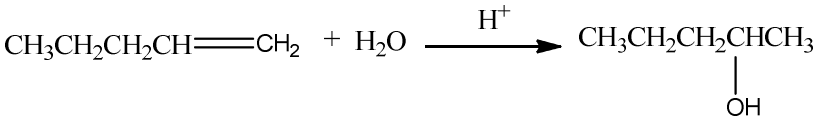
c) Using curly arrows, show the mechanism for the reactions given below:

i)



(4 marks)

ii)



(4 marks)

d) Describe simple chemical tests that would distinguish between:

i. Butane and 1-butene (3 marks)

ii. 1-butyne and 1-butene (3 marks)

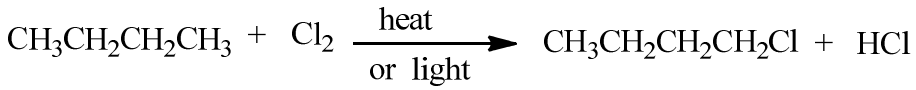
QUESTION THREE (20 MARKS)

a) i) Define the term isomerism (1 mark)

ii) Provide the structures and names of two constitutional isomers of C_5H_{12} (2 marks)

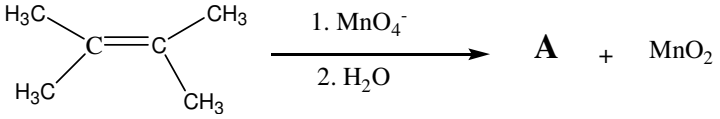
b) i) Define the term chain reaction (1 mark)

ii) The reaction below proceeds by a mechanism similar to that of chlorination of methane.



Write the equations for the chain-initiating, chain-propagating and chain-terminating steps for the above reaction. (3 marks)

c) 2,3-dimethylbut-2-ene reacts with cold dilute potassium permanganate to produce compound A as shown below. Write down the structural formula of A and show the reaction mechanism involved.



(3 marks)

d) i) Distinguish between S_N1 and S_N2 reactions (2 marks)

ii) Explain four factors that influence the rates of S_N1 and S_N2 reactions (8 marks)

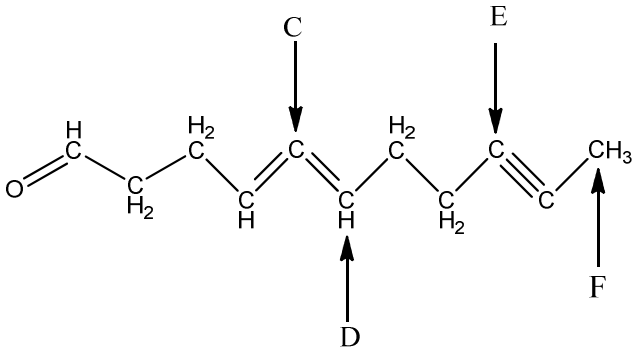
QUESTION FOUR (20 MARKS)

a) Distinguish the following terms:

i. Nucleophile and electrophile

ii. E1 and E2 reactions (4 marks)

b) Identify the type of hybridization for each of the following labeled carbon atoms in the following structure.



(2 marks)

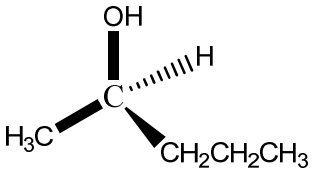
c) i) Define a functional group (1 mark)

ii) Write the functional group of esters, ethers, carboxylic acids, ketones and aldehydes (5 marks)

iii) An alcohol and ether have the same molecular formula C_2H_6O. Draw their structural formula and indicate their functional groups. (2 marks)

d) i) Differentiate between a chiral carbon and achiral carbon (2 marks)

ii) Using the (S) and (R) configurations, name the following compounds:



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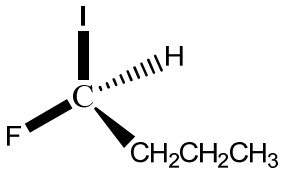


II (4 marks)

QUESTION FIVE (20 MARKS)

a) Define the following terms as used in organic chemistry:

i. Carbocation

ii. Catenation

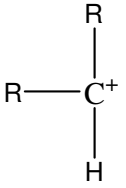
iii. Markovnikov's rule

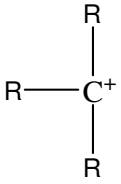
iv. Enantiomers

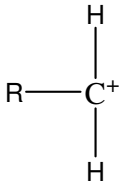
v. Regioselective reaction

vi. Chiral molecule (6 marks)

b) Given that R in the following carbocations represents alkyl groups. Arrange the carbocations in order of stability starting with the least stable. Briefly explain the order.

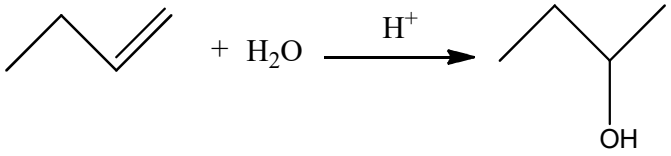






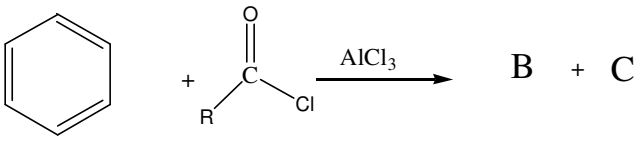
(4 marks)

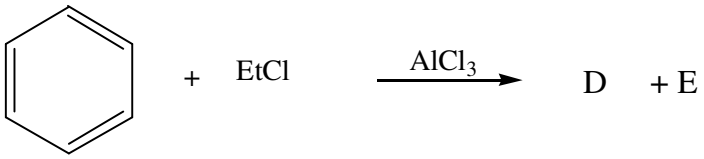
c) Butene react with water in the presence of sulphuric acid to produce 2-butanol as the major product as shown below. Show the reaction mechanism for the reaction.



(4 marks)

d) Complete the following reactions by giving the structures of the missing products:

i)  (2 marks)

ii)  (2 marks)

iii) $CH_2CH_2 + O_2 \longrightarrow G + H + Heat$ (2 marks)